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Translation of the Annex to the IPER

1. A hybrid reactor for anaerobic waste water treatment, combining the UASB (Upflow Anearobic Sludge Blanket) Process, making use of microorganism pellets, and the fixed-bed immobilization of microorganisms and comprising the following features:
   (a) carrier elements for part of the height of the hybrid reactor for immobilizing microorganisms;
   (b) a lower portion of the hybrid reactor, between the lower confines thereof and the carrier elements, in the form of a space for degradation of waste water contamination by microorganism pellets;
   (c) an upper portion of the hybrid reactor between the upper confines thereof and the carrier elements;
   (d) a supply line for waste water to be treated and to be introduced into the hybrid reactor for the first time;
   (e) a discharge system for finally discharging treated waste water from the hybrid reactor,

   characterized by the following features:
   (f) a central flow channel extending from the top in downward direction and terminating at the top with a first distance from the upper reactor confines and terminating at the bottom with a second distance from the lower reactor confines;
   (g) the carrier elements positioned in the annular space between the central flow channel and the reactor wall for the entire height of the flow channel or for part of the height of the flow channel for immobilizing microorganisms in the form of a structured, ordered fixed bed, are in the form of carrier elements that are porous to permit flow therethrough, and are arranged with flow passages of a width within a predetermined width range between adjacent carrier elements;
   (h) a separator system serving to retain the microorganisms floating in the waste water in the hybrid reactor is provided in said upper portion of the hybrid reactor below said discharge system;

(i) the hybrid reactor, with respect to the internal flow thereof, is in the form of a loop-type column reactor such that waste water contained therein, inclusive of microorganism pellets, can be circulated through the central flow channel in downward direction, then through said space in said lower portion, then along the carrier elements in upward direction and finally again into the central flow channel.

2. A hybrid reactor according to claim 1,
characterized in that plate-shaped carrier elements are provided.

3. A hybrid reactor according to claim 2,
characterized in that a plurality of packages of carrier elements are distributed across the circumference of the hybrid reactor, with the plate-shaped carrier elements within each package being arranged parallel to each other and in tangential direction of the hybrid reactor.

4. A hybrid reactor according to any of claims 1 to 3,
characterized in that the flow passages between adjacent carrier elements have a width of 3 to 6 cm, preferably 3.5 to 5.5 cm.

5. A hybrid reactor according to any of claims 1 to 4,
characterized in that carrier elements are provided that consist substantially of plastics particles and expanded clay particles that are unified with each other.

6. A hybrid reactor according to any of claims 1 to 5,
characterized by a recirculation system comprising a withdrawal means for waste water and a supply means for waste water for flow delivery into the central flow channel.

7. A hybrid reactor according to claim 6,
characterized in that the withdrawal means comprises an intermediate space between two plate-like elements as well as a conduit starting in said intermediate space.

8. A hybrid reactor according to any of claims 6 to 7,
characterized in that the discharge system is positioned a distance above the withdrawal means of the recirculation system.

9. A hybrid reactor according to any of claims 1 to 8,
characterized in that the separator system comprises a partition provided in spaced apart manner above the upper end of the central flow channel and covering a large part of the reactor cross-sectional area while leaving free an outer annular area.

10. A hybrid reactor according to claim 9,
characterized in that the partition has portions in which is does not extend horizontally and forms a gas collection space in a highest portion.

11. A hybrid reactor according to claim 10,
characterized in that, from the highest portion, the partition extends – roughly speaking – outwardly in downwardly inclined manner and inwardly in downwardly inclined manner.

12. A hybrid reactor according to claim 6 and any of claims 9 to 11,
characterized in that the withdrawal means of the recirculation system is positioned at the upper side of the partition.

13. A hybrid reactor according to any of claims 1 to 12,
characterized in that a first discharge line for gas formed in the hybrid reactor starts in the upper portion of the hybrid reactor.

14. A hybrid reactor according to any of claims 9 to 13,
characterized in that a second discharge line for gas formed in the hybrid reactor starts in the region of the partition.

15. A hybrid reactor according to any of claims 1 to 14,
characterized in that carrier plates are positioned in 15 to 40 %, preferably 20 to 30 %, of the reactor volume.

16. A hybrid reactor according to any of claims 1 to 15,
characterized in that said lower portion of the hybrid reactor has a flow deflection means positioned on the wall thereof.

17. A hybrid reactor according to any of claims 1 to 16,
characterized by at least one one driving jet outlet terminating below the lower end of the central flow channel.

18. A hybrid reactor according to any of claims 1 to 17,
characterized in that it is designed such that different kinds of microorganisms are provided as immobilized microorganisms on the one hand and as microorganisms of the microorganism pellets on the other hand.

19. A process for anaerobic waste water treatment in a hybrid reactor combining the UASB (Upflow Anearobic Sludge Blanket) Process, making use of microorganism pellets, and the fixed-bed immobilization of microorganisms, in which the waste water to be treated circulates in the hybrid reactor, such that waste water inclusive of microorganism pellets

(a) flows through a space in the lower portion of the hybrid reactor;

(b) then, in a space of the hybrid reactor located thereabove, flows along microorganisms that are immobilized in the form of a structured, ordered fixed bed on carrier elements that are porous to permit flow therethrough and form flow passages between each other;

(c) then flows to a separator system serving to retain microorganisms floating in the waste water in the hybrid reactor and separating the waste water into a first partial flow poorer in microorganisms floating in the waste water, and a second partial flow richer in microorganisms floating in the waste water;

(d) and finally, in the second partial flow, flows centrally in the hybrid reactor from the top in downward direction back into the space in the lower portion of the hybrid reactor.

20. A process according to claim 19,
characterized in that part of the waste water of the first partial flow is branched off and pumped into a portion of the central flow as recirculation flow.

21. A process according to any of claims 19 to 20,
characterized in that different kinds of microorganisms are provided as immobilized microorganisms on the one hand and as microorganisms of the microorganism pellets on the other hand.

22. The use of the hybrid reactor according to any of claims 1 to 18 or of the process according to any of claims 19 to 21 for anaerobic waste water treatment of a plant of the beverage industry, the feeding stuff industry or the food processing industry.

23. The use of the hybrid reactor according to any of claims 1 to 18 or of the process according to any of claims 19 to 21 for anaerobic waste water treatment of a plant of the paper industry or the textile industry.